3A2
03
O3C

Code 03
Copy 14

AD A049020

AD No.
DDC FILE COPY

SEA ICE GROWTH IN POTENTIAL ARCTIC MINEFIELD AREAS

by

Donald J. Gerson
Rudolph J. Perchal
Naval Oceanographic Office
Washington, D. C. 20390

NAVOCEANO Technical Note 7700-11-73

16 April 1973

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: Technical Note 7700-11-73
2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER
4. ~~TITLE (and Subtitle)~~: Sea Ice Growth in Potential Arctic Minefield Areas.
5. TYPE OF REPORT & PERIOD COVERED
6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): Donald J. Gerson, Rudolph J. Perchal
8. CONTRACT OR GRANT NUMBER(s)
9. ~~PERFORMING ORGANIZATION~~ NAME AND ADDRESS: U.S. Naval Oceanographic Office, Washington, D.C. 20373
10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS: U.S. Naval Oceanographic Office, Washington, D.C. 20373
12. REPORT DATE: 16 April 1973
13. ~~NUMBER OF PAGES~~: 16
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office): 12 19p.
15. SECURITY CLASS. (of this report): UNCLASSIFIED
15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report): 14 NOO-TN-7700-11-73

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)
18. SUPPLEMENTARY NOTES: Paper presented at 16th Technical Conference on the Naval Minefield.
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Oceanography	Winds
Ice Growth	Air Temperature
Arctic Ocean	Mine Laying

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

An empirical method of determining the date of initial ice formation using daily air temperatures is described and applied to Zubov's and Kolesnikov's equations to determine day-to-day growth in ice thickness. Several methods are used also to estimate ice drift and disintegration.

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

SEA ICE GROWTH IN POTENTIAL ARCTIC MINEFIELD AREAS*

ABSTRACT: Knowledge of ice thickness is critical to the emplacement of certain mines. Growth of sea ice in Arctic areas is related to various meteorological and oceanographic parameters. Kolesnikov's equation indicates that the most important factors are the equivalent air temperature, snow thickness and density, initial ice thickness, and wind speed under 10 knots. For lack of these data during periods of national crisis, this equation is best suited to preparation of atlases of average and extreme ice thickness from historical data. Application of Zubov's equation to daily observed or forecasted temperature data may provide an adequate estimate of day-to-day sea ice thickness for use in mine laying operations. Both methods require knowledge of the date of initial formation of ice and since that date is usually not available, an empirical method of determining this event utilizing only average daily temperatures should be used. In addition, since ice in a target area may have formed elsewhere and drifted into the area, it is necessary to understand the mechanism of ice drift and a method of its estimation. During the disintegration phase, ice thickness reduces very rapidly and an empirical method must be employed to determine the effect of warming on the ice sheet. Several of these methods are presently being used for fleet support.

I. INTRODUCTION

Considerable mention has been made today of weapons delivered from the air into the water environment. Let us consider the potential impediment to that delivery by sea ice. When sea ice attains a particular thickness, and is present in sufficient quantity in Arctic or sub-Arctic ports, emplacement of some types of mines becomes impossible. It is therefore necessary to have a means of predicting these critical ice parameters. This paper discusses two methods of predicting when a certain ice thickness and amount of surface coverage (concentration) will occur.

(a) The first of these methods being developed for naval commands and Fleet units is an atlas of ice conditions derived from environmental

*This paper was presented at the 16th Technical Conference of the Naval Minefield Community and will be published in the classified proceedings of that conference.

factors related to ice formation and growth; the second is a forecast of ice thickness based on real-time observation and prediction of these environmental factors.

(b) An atlas of detailed ice conditions based on historical observations might be attempted. It would contain data on the earliest, average, and latest dates of initial ice formation, as well as periodic charts containing isolines of the average and extreme thicknesses of sea ice. Such an atlas would require a considerable amount of observed ice data. Since freezeup and ice thickness data are not available to the extent needed, ice conditions in various strategic locations must be estimated by one of the two methods mentioned above.

(c) Sea ice in a particular location, however, may have drifted into the area in response to wind and water currents and have a thickness different from the surrounding ice. This causes a problem in that locally formed ice may be thin enough to permit emplantment of mines, but the advected ice may be too thick for mine penetration. Ice drift will be discussed later in this paper. The following discussion deals with the growth of ice which forms locally and remains in place.

COMPUTING GROWTH OF LOCALLY FORMED ICE FOR ATLAS PRESENTATION

2. (U) Kolesnikov (1) derived an equation for the growth of sea ice which involves many meteorological and oceanographic variables. Callaway (2) analyzed these variables and concluded that snow thickness and density, equivalent air temperature, initial ice thickness, and wind speed under 10 knots were the most important factors. By using observed data for the critical variables, and assuming reasonable values for snow density and for some less critical meteorological variables that were not available, Callaway found close agreement between computed and observed ice growth at a number of widely separated Arctic locations. At one location, Archangel, computed and observed ice growth averaged over a 12-year period for three different ranges of snow depth and initial ice thickness also showed close agreement. Therefore, it seems reasonable to conclude that average and extreme values of significant environmental factors in the Arctic may be used to compute average and extreme ice growth.

(a) For the practical calculation of ice growth with the degree of accuracy required for atlas presentations, Kolesnikov's equation may be reduced to:

$$(\Delta H)^2 + [12.1d + \frac{90}{1.75V_0{}^{0.656}} + 2H_1]\Delta H = 10.8 \sum_{i=1}^{D} \frac{-(1.9+\theta_i)}{1-.005(1.9+\theta_i)} \qquad (1)$$

where: ΔH = increase in ice thickness (cm)
d = snow depth (cm)
V_0 = wind speed (m/sec)
H_1 = initial ice thickness (cm)
D = days over which ΔH is calculated
θ_i = equivalent air temperature (°C)

assuming: snow density = 0.33 g/cm^3
ice salinity = 3.2 ‰
ice density = 0.916 g/cm^3
sea water salinity = 35 ‰
sea water density = 1.028 g/cm^3
freezing temperature = -1.9°C
specific heat of sea ice = 0.70 cal/g
specific heat of sea water = 0.94 cal/g

(b) Synoptic observations of air temperature and wind speed have been taken regularly for many years at stations in the Arctic and sub-Arctic. These data have been used to derive isopleth charts of mean monthly conditions; therefore, interpolations of mean temperature and wind can be made for any point for input to equation (1). Interpolations from maximum and minimum monthly mean air temperature and wind speed charts can be used as a partial input to equation (1) for estimating the extreme profiles of ice growth at any point. The extreme totals of frost degree days accumulated during any ice growth season could be used as input for computation of the probable observed extremes of ice growth.

(c) Snow depth probably is the most difficult factor to measure in computing growth of sea ice. Fluctuating depths in time and space caused by variable winds and local topography often cause measurements taken at a location to be nonrepresentative of the overall accumulation. In particular, the vast majority of snow depth data are taken at land stations, and these observations may differ significantly from the snow depth on sea ice which is the required input to equation (1). Because of the relatively large dependence of ice growth on snow depth, atypical depth observations probably are the largest source of error in computing growth of sea ice.

(1) In order to develop insight concerning snow depths for input to equation (1) it is necessary to examine snow accumulations which have been found by several investigators to be representative.

(2) Bilello (3) found that a 7-year average seasonal snow depth in the Canadian Arctic generally increased linearly to 10 cm between 5 September and 15 November with an additional linear increase of 10 cm from 15 November to 30 April. Maykut and Untersteiner (4) assumed a linear accumulation over the central Arctic of 30 cm between 20 August and 30 October, a linear increase of 5 cm from 1 November to 30 April, and an additional 5 cm during May. This snow accretion is twice that found by Bilello and may be ascribed to the difference in location.

(3) Long-term atlas data generally support the larger depths used by Maykut and Untersteiner over much of the Arctic, if a single model

of snow accretion were to be used for input to equation (1). However, small total accumulations (<10 cm) shown by atlas data along a considerable part of the northern Soviet coast indicate that snow over the Arctic may not accumulate uniformly enough for a single depth model to be assumed. Nonuniformity of snow accretion indicates that average and extreme seasonal growth profiles should be computed for small sectors. Values of snow depth, mean and extreme temperatures, and wind data may be entered into equation (1) to derive the distributions of average and extreme sea ice growth for atlas presentation.

COMPUTING REAL-TIME GROWTH OF LOCALLY FORMED ICE

3. (U) Atlas presentations are valuable as a planning tool; however, atlases are not usually sufficient for tactical operations. A real-time forecast is necessary to determine ice conditions for such operations. Numerous equations have been developed for predicting ice thickness. Some of these can be used to relate ice thickness only to the accumulation of frost degree days. Although more detailed equations and techniques have been formulated, e.g., Lee and Simpson (5) and the method described above, the additional environmental factors required are neither observed nor reported daily. Even if they were observed daily, transmission of these data probably would be subject to communication restriction or total blackout during periods of national crisis. Therefore, empirically derived equations for specific locations relating ice growth to frost degree day accumulations are a valuable means for estimating ice growth, assuming some means of at least estimating temperatures. We will now consider equations dependent only on frost degree day accumulations.

(a) By definition, a frost degree day is a deficit of one degree below the freezing temperature of the water for one day. If on one particular day the mean temperature is 4 degrees below freezing, then 4 frost degree days are collected for that day and these are added to the accumulated total (figure 1). One difficulty in collecting frost degree days is to determine the point when the accumulation is to begin. Temperatures usually fluctuate above and below freezing for several days prior to remaining below freezing (figure 2). It is usually on the day when temperatures remain below freezing that the frost degree day collection begins. Most methods require the collection to begin when ice first forms, but since the time of that event is not usually known, the date after which temperatures remain below freezing often is used. A method for forecasting initial freezeup is discussed below.

(b) For stations at which a great deal of temperature data are available, maximum and minimum running totals of frost degree days, as well as normal accumulations, can be calculated as shown in figure 3 from Kniskern and Potocsky (6). For ports where abundant air temperatures and ice information are available, it is possible to formulate theoretical curves relating degree day accumulations with ice thickness. When historical ice data are sparse an equation developed by Zubov (7) can be used. This equation in slightly modified form is:

$$H_j^2 + 50\ H_j = 8 \sum_{i=1}^{j} D_i \tag{2}$$

where: H_j = ice thickness (cm) on day j
D_i = degree day accumulation (°C) on day i

By converting to degrees Fahrenheit and inches and solving for H_j

$$H_j = \frac{\sqrt{817.96 + 5.808 \sum_{i=1}^{j} D_i}}{2.904} - 9.85 \tag{3}$$

(c) This equation can be used with daily temperature data to compute near real-time ice thickness, and with long-range temperature forecasts to predict ice thickness.

ICE DRIFT

4. (U) We previously mentioned a problem of ice of different thickness drifting into an area of known or calculated ice thickness. Sea ice dynamics, notably ice drift, is one of the most intensively studied areas of environmental effects on sea ice. From Nansen's historic studies on the drift of the FRAM to the present massive AIDJEX (Arctic Ice Dynamics Joint Experiment) project, there has been considerable interest in ice motions.

(a) Five basic forces result in translational ice motion. The equation of stationary equilibrium is:

$$F_a + F_w + \Omega + P + R = 0 \tag{4}$$

where: F_a = frictional stress of air
F_w = frictional stress of water
Ω = Coriolis force
P = force resulting from horizontal pressure gradient in the sea
R = force resulting from interaction with surrounding ice floes

Most early studies considered only the first three terms of this equation. The fourth and fifth terms have been considered only recently. Doronin (8) published a paper which, in addition to the above, considered redistribution of ice or changing concentration. He also gave a method for calculating ice drift and changes in concentration using available meteorological parameters. We are now evaluating the method for potential implementation.

(b) The method presently used for determining ice drift is vectorial addition of wind and current drift. The wind drift vector is obtained from table 1 and figure 4. Magnitude of this vector is found from table 1 which gives the 24-hour drift as a percentage of surface wind speed for various ice concentrations and roughness factors. For example, sea ice of 4 oktas concentration and 5 tenths ridging and hummocking will drift, in 24 hours, a distance equal to 70% of the average speed during the 24-hour period; that is, 7 NM with a 10-knot wind, 14 NM with a 20-knot wind, etc. This table, presented by Zubov (7), was modified for concentration in oktas (eighths) and for 24-hour drift. The direction of drift is determined from a graph based on the work of Shuleikin (9), figure 4, in which the drift of ice to the right (Northern Hemisphere) of the surface wind direction (deviation angle) is given as a function of surface wind speed and ice thickness. For example, sea ice 4 feet thick will drift 35° to the right of a 10-knot surface wind, 24° to the right of a 30-knot surface wind, etc. Current drift is obtained from atlases, such as reference (10). Using this technique for a 24- to 48-hour period, during which little ice disintegration is assumed, reasonable estimates of the total ice drift can be prepared manually.

(c) These values of drift, over a grid, can be used to calculate convergence and divergence and resulting changes in ice concentration. Restriction to the free movement of ice due to coastlines or fast ice would have to be considered.

ICE DISINTEGRATION

5. (U) Changes in concentration as well as changes in ice thickness can be caused by ice disintegration. Although most models of seasonal change in the sea ice canopy indicate a period of decreased ice thickness, few attempts have been made to empirically relate the rate at which sea ice thickness decreases to environmental factors. Theoretical equations similar to those available for sea ice growth are lacking, owing to the many physical and mechanical processes involved in the decay process.

(a) However, two important facts are well known. First, an accumulation of warming degree days equal to approximately 10 percent of the accumulated frost degree days needed to grow the ice is required to completely disintegrate this ice using the same base temperature. Secondly, mechanical weakening of the ice cover proceeds rapidly.

(b) Based on limited data, Assur (11) found that ice thickness diminishes according to the relation:

$$\Delta H = 0.1524 \sum D_i \tag{5}$$

where $\sum D_i$ is accumulated warming degree days above -12.2°C, and ΔH is ice thickness in cm. Bilello (3) derived the equation:

$$\Delta H = 0.55 \sum D_i \tag{6}$$

where $\sum D_i$ is accumulated warming degree days above -1.8°C, and ΔH is ice thickness in cm, based on observations of decreasing sea ice thicknesses at four Canadian stations. D. B. Karelin as referenced by Bilello developed the equation:

$$\Delta H = 0.51(\sum D_i - 32) \tag{7}$$

apparently based on data from the Russian Arctic, where $\sum D_i$ is the accumulated warming degree days above -5°C and ΔH is ice thickness in cm. .

(c) Note that the three empirical equations use different coefficients and different base temperatures for determining the warming degree days. Preliminary tests also show that their application results in different rates of decrease in ice thickness. Therefore, more investigation is needed before automated forecasting techniques can be applied.

INITIAL ICE FORMATION

6. (U) Bilello (3) has applied an empirical method for determining initial formation of ice based on an earlier investigation by Rodhe (12). Gerson (13) has applied this technique for predicting the initial formation of ice in order to determine the inception of frost degree day accumulations in conjunction with forecasts of sea ice thickness and to give warnings to appropriate military and commercial interests.

(a) This method requires the use of only air temperatures, thus assuming all other factors to be local in nature and fixed for the station. These characteristic factors are grouped into a single weighting factor called Z, which is determined for each year at a particular station using known air temperatures and the date of freezeup. The equation used to determine initial freezeup is:

$$M_i = M_{i-1} + Z(T_i - M_{i-1}) \tag{8}$$

where: Z = the weighting factor
M_i = a recursion variable with M_0 the average temperature of a base month
$i = 1,2,3,\ldots$ where 1 is the first day after the base month
T_i = daily temperatures for the ith day after the base month

(b) In order to determine Z, several years of air temperatures and corresponding freezeup dates must be available for each station. A value of Z is determined for the years when data are available and an average is then used for each station. The values of Z are determined by an iterative procedure. A transformation of equation 8 is used to determine an initial value of Z from the historical data as follows:

$$Z_1 = \frac{T_f - M_0}{\sum_{i=1}^{N} (T_i - M_0)} \tag{9}$$

where: T_f = local freezing temperature of water
N = the value i achieved to produce initial ice
and other variables are as for equation 8.

This initial value of Z is then applied to equation 8 recursively until $i=N$, thus determining M_N. If at this point $M_N \neq T_f$, Z_j is adjusted by the equation:

$$Z_{j+1} = kZ_j(T_f - M_N) \tag{10}$$

where the constant k must be chosen small enough so that the process converges but large enough to avoid excess computer time. A value of 0.01 has been used successfully.

(1) The new value of Z is then applied to a slight modification of equation 8 which becomes:

$$M_i = M_{i-1} + Z_j\,(T_i - M_{i-1}) \tag{11}$$

and the process is repeated until

$$\left| T_f - M_N \right| < C \tag{12}$$

where the constant C is chosen from knowledge of the behavior of M_N as it approaches T_f. A value of 0.1 has been used successfully. Therefore:

$$Z = Z_j \text{ if } \left| T_f - M_N \right| < C \tag{13}$$

where Z is the weighting factor of equation 8.

(c) When the average Z is determined for a station it can be utilized in equation 8 to predict N, the freezeup date. The base month chosen for obtaining the mean temperature M_0 is a month which produces the least variability in Z. In all cases thus far, July has been used as the base month.

(d) For forecasting application, it is necessary to have temperatures T_i for input into equation (8) until $M_i = F$. To obtain these temperatures a combination of observed, forecast, and normal temperature data are used in a replacement scheme. On the first and 15th of each month temperatures are forecast for 30 days. These values replace the last 15 days of the previous forecast and the succeeding 15 days of normal temperatures. Each day, the observed temperature replaces the forecast temperature for that date. Thus, as the date approaches the date of initial ice formation, the forecast should become more accurate. A problem exists, however, in that the value Z is not constant. For some stations, Z can fluctuate as much as an order of magnitude. Implementation of a method to predict Z using meteorological parameters other than temperature is the subject of present investigation.

PRESENT APPLICATIONS

7. (U) The Naval Oceanographic Office currently produces automated daily outputs of 6-hourly and average daily temperatures, degree-day accumulations for 62 Arctic and sub-Arctic stations, and sea surface temperature collections. Zubov's equation for ice growth is being used to calculate near real-time ice thicknesses and to forecast ice growth in conjunction with air temperature forecasts. These air temperature forecasts are also being used to provide forecasts of initial freezeup by applying the method used by Gerson (13).

(a) Application of the simplified form of Kilesnikov's equation for ice growth may be used to increase the accuracy of near real-time thick-

ness estimates and ice growth forecasts, as well as for the preparation of ice formation for atlas presentation. The feasibility for automating ice drift and concentration change computations for inclusion in this system is being evaluated. This would permit estimates of changes of concentrations due to ice drifting into and out of an area, as well as estimates of ice thickness.

(e) Products resulting from this automated system are designed to aid the environmental forecaster in providing improved assistance to operating Fleet units. Information contained in atlas presentations is designed to aid in the planning stages of Fleet operations.

REFERENCES

1. KOLESNIKOV, A. G. On the theory of ice accretion on tne sea surface, Problems on Marine Hydrological Forecasts. Leningrad, 1946.

2. CALLAWAY, L. B. An Analysis of Environmental Factors Affecting Ice Growth, TR 7, Navy Hydrographic Office, 1954.

3. BILELLO, M. A. Formation, Growth and Decay of Sea Ice in the Canadian Arctic Archipelago, Research Report 65, Snow, Ice, and Permafrost Research Establishment, 1960.

4. MAYKUT, G. A. and UNTERSTEINER, N. Some results from a time-dependent thermodynamic model of sea ice. J. Geophysical Res., 76, 1550-1575, 1971.

5. LEE, O. S. and SIMPSON, L. S. A Practical Method of Predicting Sea Ice Formation and Growth, TR 4, Navy Hydrographic Office, 1954.

6. KNISKERN, F. E. and POTOCSKY, G. J. Frost Degree Day, Related Ice Thickness Curves, and Harbor Freezeup and Breakup Dates for Selected Arctic Stations, TR 60, Naval Oceanographic Office, 1965.

7. ZUBOV, N. N. Arctic Ice, Moscow, 1942. (Translated for Air Force Cambridge Research Center by Naval Oceanographic Office and American Meteorological Society.)

8. DORONIN, Y. P. On a method of calculating the compactness and drift of ice floes, Proc. Arctic Antarctic Res. Inst., 291, 5-17, 1970 (Translation in AIDJEX Bull. No. 3, 22-39, 1970.)

9. SHULEIKIN, V. V. Fizika Moria, izdanie tret'e. (Physics of the Sea, 3rd ed.) Moscow, Press of the Academy of Sciences of the USSR, 1953.

10. U.S. Navy Hydrographic Office, Oceanographic Atlas of the Polar Seas, Part II, Arctic, H. O. 705, Washington, 1958.

11. ASSUR, A. Air Fields on Floating Ice Sheets, Snow Ice, and Permafrost Research Establishment, Report 36, 1956.

12. RODHE, B. On the relation between air temperature and ice in the Baltic, Geografiska Annaler, 34, 175-202, 1952.

13. GERSON, D. J. Automated forecasting of harbor ice formation, presented at the 52nd Annual Meeting of the American Geophysical Union, 1971 (unpublished).

TABLE 1

RESPONSE FACTOR (PERCENT) FOR OBTAINING WIND DRIFT OF SEA ICE (NM/DAY) FROM WIND SPEED (KNOTS) FOR VARYING CONCENTRATION AND RIDGING

Extent of ridging and hummocking (tenths)	Total concentration of ice (oktas) 0-1	1	2	3	4	5	6	7	7-8
1	23	21	18	15	12	9	8	6	6
2	45	42	36	30	25	20	16	13	11
3	67	63	56	49	42	35	27	20	17
4	89	85	75	64	55	45	35	26	21
5	112	106	94	82	70	58	46	34	28
6	134	127	112	98	84	71	56	41	34
7	156	148	131	115	98	82	65	49	41
8	179	169	150	133	114	95	76	57	47
9	201	190	169	146	125	104	84	63	53

FROST DEGREE DAYS
(BASE 32° F)

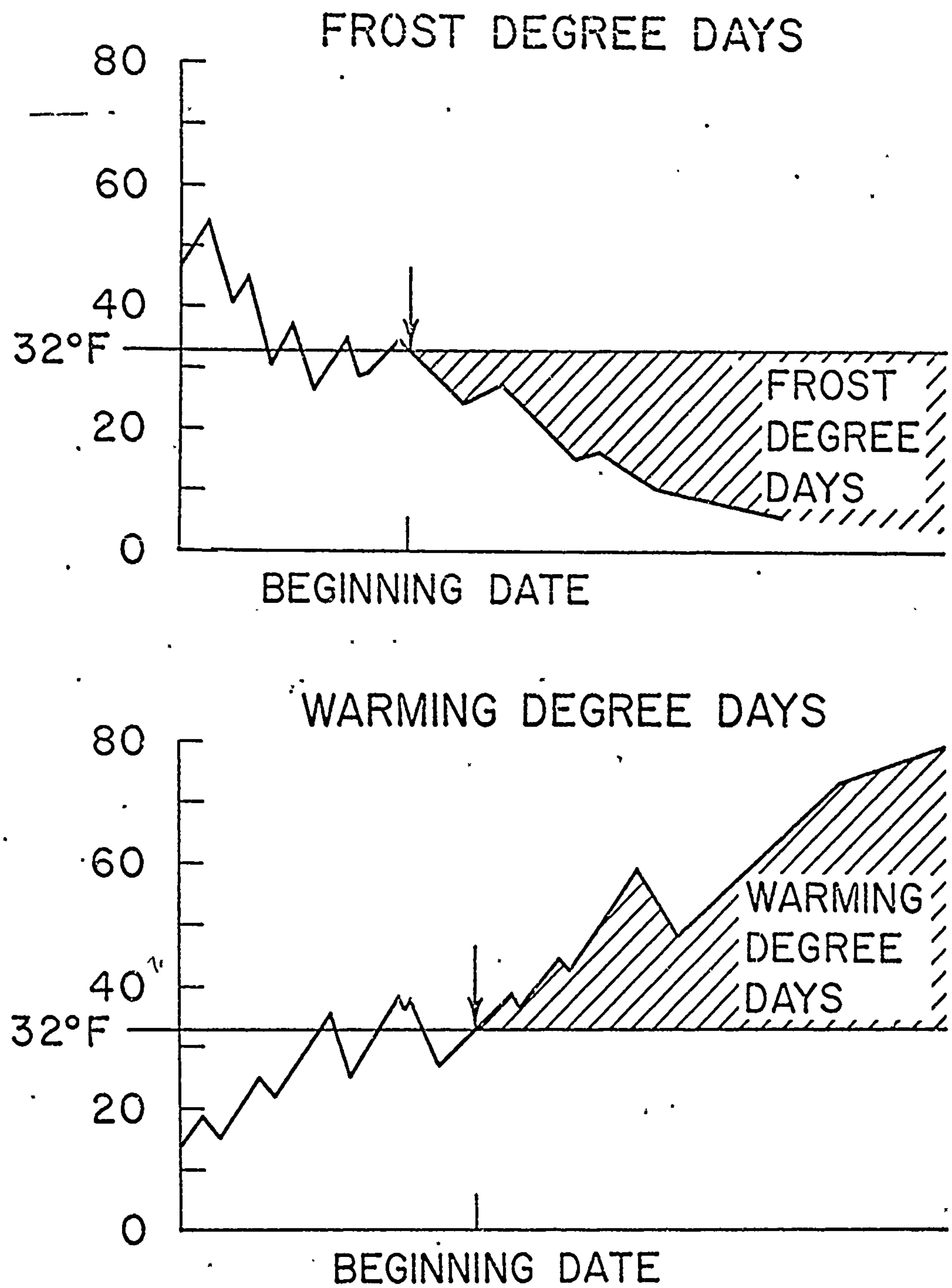
TEMPERATURE	DEGREE DAYS	ACCUMULATED DEGREE DAYS
34°	—	0
36°	—	0
28°	4	4
24°	8	12
18°	14	26

WARMING DEGREE DAYS

TEMPERATURE	DEGREE DAYS	ACCUMULATED DEGREE DAYS
30°	—	0
28°	—	0
34°	2	2
38°	6	8
42°	10	18

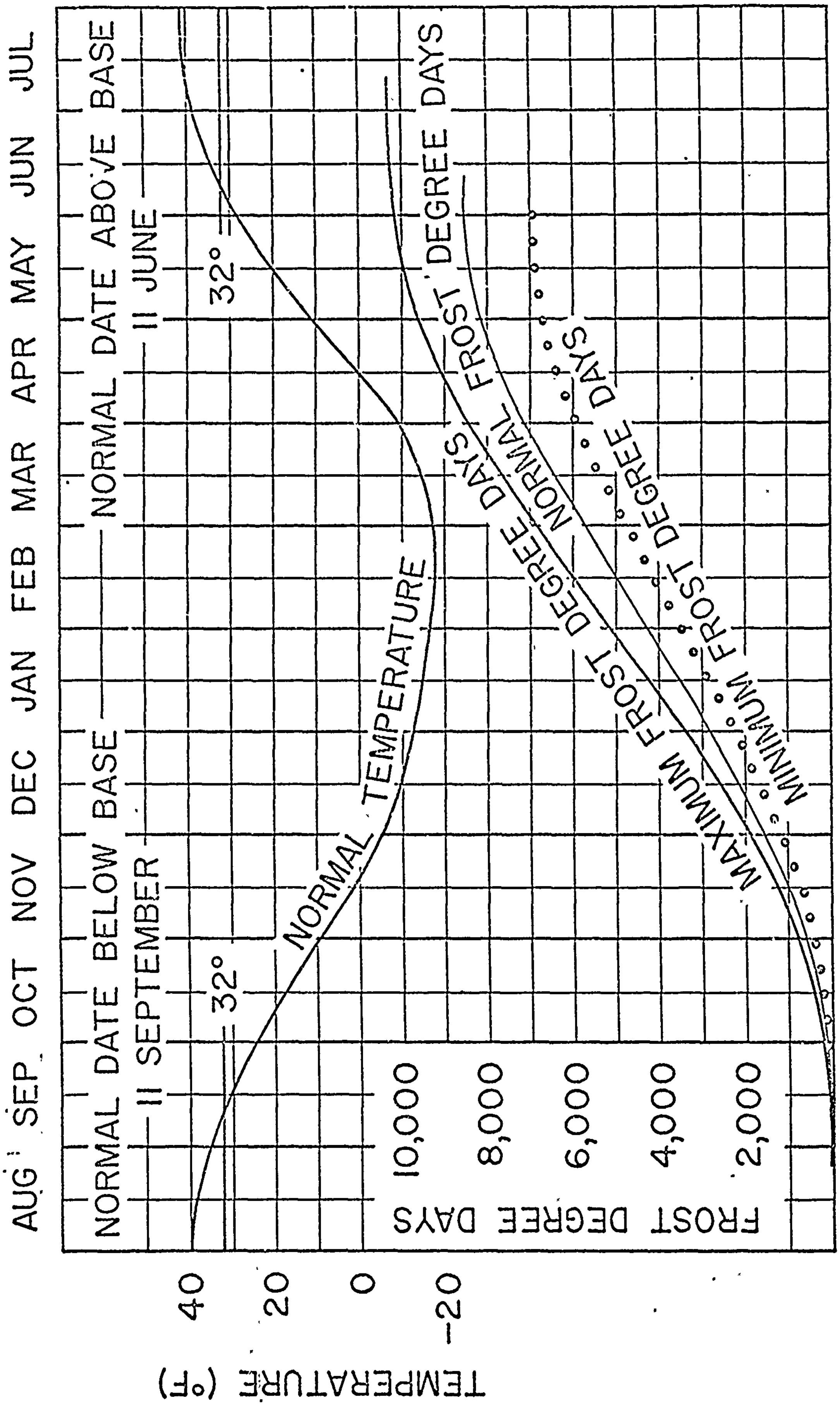
DEGREE-DAY COLLECTIONS

FIGURE 1

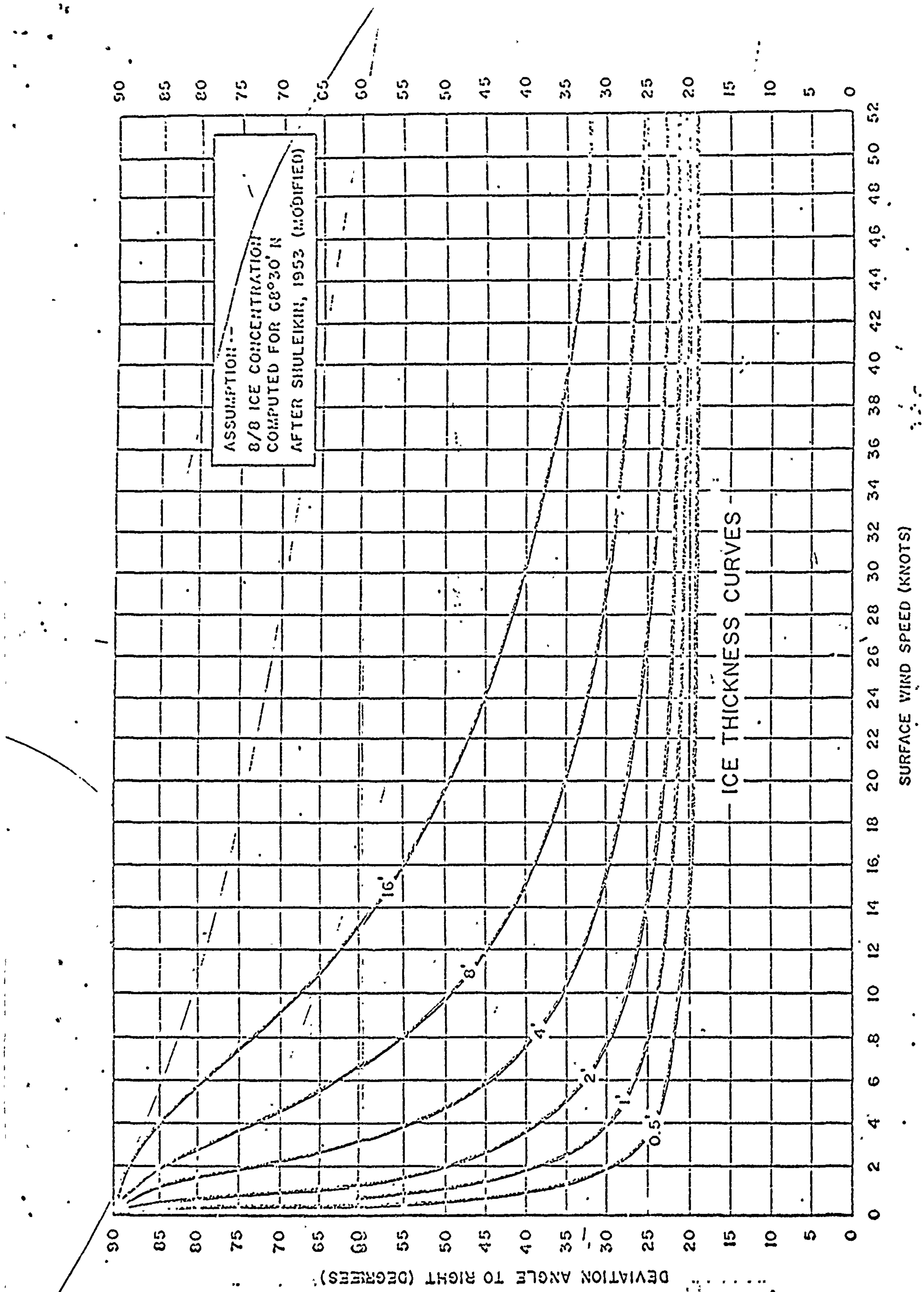


DETERMINATION OF STARTING DATE OF DEGREE DAY COLLECTIONS

FIGURE 2



POINT BARROW NORMAL TEMPERATURES AND DEGREE DAY ENVELOPE
(30 YEARS' RECORD)
FIGURE 3



ICE DRIFT DIRECTION FOR VARYING WIND SPEED AND ICE THICKNESS

FIGURE 4

DISTRIBUTION LIST

DATE: 16 April 1973

SERIAL: 7700-11-73

SUBJECT: Sea Ice Growth in Potential Arctic Minefield Areas

TECHNICAL NOTE *	EVALUATION REPORT
PROGRESS/STATUS REPORT	OTHER
SYSTEMS ANALYSIS REPORT	
LETTER	

*Presented at the 16th Technical Conference of the Naval Minefield Community

CLASSIFICATION: Unclassified

NUMBER OF COPIES MADE: 25

COPY NO.	(Internal)	COPY NO.	
1	Code 01	21	
2	Code 06	22	
3	Code 06A	23	
4	Code 06B'	24	
5	Code 30	25	
6	Code 33		
7	Code 70		
8	Code 73		
9	Code 74		
10	Code 75		
11	Code 76		
12	Code 7005		
13	Code 7003		
14	Code 03		
15	Code 7700		
16	Code 7710		
17	Code 7720		
18			
19			
20			

REMARKS: